CLAIMS

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I claim:

1. A solid state electrical switch for controlling a electrical load, comprising:

a first terminal;

a second terminal;

a semiconductor switch coupled by said first terminal and said second terminal to form with said electrical load a series circuit across said AC power source, said semiconductor switch becoming conducting in response to receiving a control signal at a control terminal, said solid state electrical switch being in an "on" state when said semiconductor switch is conducting and in an "off" state when said semiconductor switch is not conducting; and

a control circuit providing said control signal, said control circuit being coupled to said first and second terminals in a parallel configuration with said semiconductor switch.

2. A solid state electrical switch as in Claim 1, wherein substantially no current flows in said control circuit during said "off" state.

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3. A solid state electrical switch as in Claim 1, wherein said control circuit is powered via said first and second terminals.

4. A solid state electrical switch as in Claim 1 wherein, said control circuit includes a dynamic feedback circuit, said dynamic feedback circuit through said control signal triggering said semiconductor switch during said "on" state into conducting at the

beginning of each half-cycle of an AC signal of said AC power source.

5. A solid state electrical switch as in Claim 1, wherein said control circuit includes only solid state static components.

6. A solid state electrical switch as in Claim 1, wherein said control circuit, which receives an electrical signal, comprises:

a rectifier receiving, during said "off" state, an AC signal from said AC power source and rectifying said AC signal to provide a rectified signal; and

a capacitor which is (a) coupled to receive said rectified signal during said "off" state; and (b) discharged in response to said electrical signal to generate said control signal, thereby rendering said semiconductor switch conducting.

7. A solid state electrical switch as in Claim 1, further comprising an overcurrent protection circuit which causes said semiconductor switch to become non-conducting when a current in said load device exceeds a predetermined value.

8. A solid state electrical switch as in Claim 7, wherein said overcurrent protection circuit comprises a current detector coupled to provide an electrical signal indicative of the current in said load device.

9. A solid state electrical switch as in Claim 1, further comprising a touch panel electrically

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coupled to said control circuit, said touch panel providing said electrical signal when said touch panel is contacted by an external agent.

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10. A solid state electrical switch as in Claim 9, wherein said electrical signal is provided by the impedance between said external agent and a ground reference.

11. A solid state electrical switch as in Claim 10, wherein said electrical signal is synthesized by complementary effects resulting from the interaction of environmental electric fields and said impedance.

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12. A solid state electrical switch as in Claim 10, wherein said impedance is primarily resistive.

13. A solid state electrical switch as in Claim 10, wherein said impedance is primarily capacitive.

14. A solid state electrical switch as in Claim 10, such that electromagnetic radiation collected by said external agent contributes to said electrical signal.

15. A solid state electrical switch as in Claim 6, said control circuit further comprising a gain circuit responsive to said electrical signal, said gain circuit coupling said rectified signal to said control terminal in response to said electrical signal.

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16. A solid state electrical switch as in Claim 15, wherein said gain circuit comprises a bipolar transistor.

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17. A solid state electrical switch as in Claim 16, wherein said gain circuit further comprises a diode coupled in an antiparallel manner between a base terminal of said bipolar transistor and an emitter terminal of said bipolar transistor.

18. A solid state electrical switch as in Claim 16, wherein said gain circuit further comprises a diode coupled in an antiparallel manner between a base terminal of said bipolar transistor and a collector terminal of said bipolar transistor, said collector terminal being coupled to receive said rectified signal.

19. A solid state electrical switch as in Claim 6, wherein said semiconductor switch becomes non-conducting when said AC signal crosses zero, whereupon said rectifier signal charges said capacitor resulting in a charging current providing said control signal.

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20. A solid state electrical switch as in Claim 15, said control circuit further comprising a second gain circuit responsive to a second electrical signal, said second gain circuit providing a bypass signal path between said control terminal and a common ground of said control circuit, thereby preventing said control signal from reaching said semiconductor switch.

21. A solid state electrical switch as in Claim 20, wherein said second gain circuit comprises a bipolar transistor.

22. A solid state electrical switch as in Claim 21, wherein said second gain circuit further comprises a diode coupled in an antiparallel manner between a

base terminal of said bipolar transistor and an emitter terminal of said bipolar transistor.

23. A solid state electrical switch as in Claim 20, further comprising an overcurrent protection circuit providing said second electrical signal when a current in said semiconductor switch exceeds a predetermined value.

24. A solid state electrical switch as in Claim 20, further comprising an initialization circuit including a second capacitor coupled between said control terminal and said common ground, said second capacitor having a capacitance larger than the capacitance of said capacitor of said control circuit.

25. A solid state electrical switch as in Claim 24, wherein said second capacitor is coupled to said control terminal by a diode.

26. A solid state electrical switch as in Claim 24, wherein said initialization circuit further comprising a resistor coupled to discharge said second capacitor to said common ground.

27. A solid state electrical switch as in Claim 6, further comprising a zero-crossing circuit coupled to receive said rectified signal and coupled to said control terminal, said zero-crossing circuit preventing said control signal from reaching said semiconductor switch except when said AC signal crosses zero.

28. A solid state electrical switch as in Claim 6, wherein said rectifier comprises a diode bridge and said semiconductor switch comprises a silicon controlled rectifier (SCR).

29. A solid state electrical switch as in Claim 1, wherein said semiconductor switch comprises a triode AC switch (TRIAC) coupled to receive said control signal.

30. A solid state electrical switch as in Claim 1, wherein said semiconductor switch comprises antiparallel silicon controlled rectifiers (SCRs) triggered by said control signal.

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31. A solid state electrical switch as in Claim 6, wherein said rectifier comprises a SCR controlled bridge rectifier.

32. A solid state electrical switch as in Claim 6, wherein said control circuit further comprises a resistor coupled in series with said capacitor between an output terminal of said rectifier and said control terminal.

33. A solid state electrical switch as in Claim 6, wherein said control circuit further comprises an attenuator circuit coupled between said capacitor and said control terminal.

34. A solid state electrical switch as in Claim 33, wherein said attenuator circuit comprises a voltage divider circuit.

35. A solid state electrical switch as in Claim 24, wherein said initialization circuit further comprises a resistor coupled in parallel with said second capacitor, wherein the time constant corresponding to the product of the resistance of said resistor and the capacitance of said second capacitor

exceeds the charging time constant of said capacitor of said control circuit.

36. A solid state electrical switch as in Claim 24, wherein said initialization circuit operates to ensure said semiconductor switch is non-conducting upon power up.

37. A solid state electrical switch as in Claim 24, wherein said initialization circuit operates such that, when a power interruption occurs while said semiconductor switch is conducting, said semiconductor switch becomes conducting if power returns within a predetermined time interval, and becomes non-conducting when power returns after said predetermined time interval.

38. A solid state electrical switch as in Claim 20, wherein said second gain circuit comprises a complementary cascade amplifier.

39 A solid state electrical switch as in Claim 9 wherein said touch panel is coupled to said control circuit through a current limiting resistor.

40. A solid state electrical switch as in Claim 9 wherein said touch panel is coupled to said control circuit through a capacitor.

41. A solid state electrical switch as in Claim 9, further comprising a low pass filter coupled to an input terminal of said control circuit.

42. A solid state electrical switch as in Claim 9, wherein said touch panel comprises a metallic surface.

43. A solid state electrical switch as in Claim 42, wherein said metallic surface is coated with a resistive material or an insulator.

44. A solid state electrical switch as in Claim 8, wherein said current detector comprises a transformer.

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45. A solid state electrical switch as in Claim 44, wherein said transformer provides a voltage output signal indicative of said current in said load device.

46. A solid state electrical switch as in Claim 7, wherein said overcurrent protection circuit comprises temperature-sensitive components, such that said predetermined value of said overcurrent protection circuit varies with temperature of the ambient.

47. A solid state electrical switch as in Claim 46, wherein said predetermined value of said overcurrent protection circuit varies with temperature of said solid state electrical switch.

48. A solid state electrical switch as in Claim 7, wherein said overcurrent protection circuit comprises:

a rectifier receiving said signal indicative of the current in said load device to provide a signal indicative of said current in said load device; and

a threshold component coupled to receive said signal indicative of the magnitude of said current in said load device, said threshold component becoming conducting when said magnitude exceeds a predetermined value.

49. A solid state electrical switch as in Claim 48, wherein said threshold component comprises a forward-biased silicon diode.

50. A solid state electrical switch as in Claim 48, wherein said threshold component comprises a Zener diode.

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51. A solid state electrical switch as in Claim 48, wherein said threshold component comprises a 4-layer Shockley diode.

52. A solid state electrical switch as in Claim 48, wherein said rectifier comprises a Zener diode.

53. A solid state electrical switch as in Claim 48, wherein said rectifier comprises a diode bridge.

54. A solid state electrical switch as in Claim 48, further comprising a resistor network between said rectifier and said threshold component, said resistor network including a thermistor.

55. A solid state electrical switch as in Claim 27, wherein said zero-crossing circuit comprising a transistor coupling said control terminal to common ground, when said instantaneous level of said rectified signal is above said predetermined value.

56. A solid state electrical switch as in Claim 55, wherein said transistor is controlled by the ~~voltage~~ output signal of a voltage divider between an output terminal of said rectifier and a common ground.

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57. A solid state electrical switch as in Claim 56, said zero-crossing circuit further comprising a light-emitting diode and a Zener diode connected in series with said voltage divider.

58. A solid state electrical switch as in Claim 9, further comprising an audio response circuit for providing an audible sound to said external agent upon contact with said touch panel.

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59. A solid state electrical switch as in Claim 58, wherein said audio response circuit comprises a Zener diode and a piezoelectric speaker element connected in series across an output terminal of said rectifier and a common ground.

60. A solid state electrical switch as in Claim 24, wherein said second capacitor comprises an electrolytic capacitor and an unpolarized capacitor coupled in parallel.

61. A solid state electrical switch as in Claim 9, wherein said touch panel is mounted in a plane offset from a mounting plate.

62. A solid state electrical switch as in Claim 9, wherein said touch panel is of a first color, and wherein said touch panel is mounted on a mounting plate of a second color different from said first color.

63. A solid state electrical switch as in Claim 20, further comprising a second touch panel electrically coupled to said control circuit, such that upon said touch panel contacting with an external agent, said touch panel provides said second electrical signal.

64. A solid state electrical switch as in Claim 63, wherein said first and second touch panels are distinguishable by tactile feel or color.

65. A solid state electrical switch as in Claim 63, further comprising an audio response circuit for generating distinguishable audible sounds to indicate which of said first and second touch panels is contacted by an external agent.

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66. A solid state electrical switch as in Claim 63, wherein when said first and second panels are each contacted by an external agent substantially simultaneously, said semiconductor switch remains non-conducting.

67. A solid state electrical switch as in Claim 1, wherein said semiconductor switch initializes to said "off" mode.

68. A solid state electrical switch as in Claim 1, further comprising an optocoupler coupled to said control circuit and receiving an input signal, said optocoupler circuit providing said control circuit an optically isolated output signal corresponding to said input signal, whereupon receiving said optically isolated output signal, said control circuit providing said control signal, thereby rendering said semiconductor switch conductive.

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69. A multipoint random control system, comprising:

a 2-terminal solid state electrical switch coupled in series with a load circuit between a phase line of an AC power outlet and a neutral

line of said AC power outlet, said solid state electrical switch being responsive to first and second control signals, wherein when said first control signal is asserted, said solid state electrical switch becomes non-conducting, and when said second control signal is asserted, said solid power switch becomes conducting;

an optocoupler coupled to said solid state electrical switch to provide said first and second control signals, said optocoupler receiving first and second electrical signals from a signal bus and providing as said first and second control signals optically isolated output signals representing said first and second electrical signals; and

a plurality of devices coupled to said signal bus, each device being capable of asserting as output signals of said devices said first and second electrical signals.

70. A multipoint random control system as in Claim 69, wherein said signal bus include a common ground signal relative to said first and second electrical signals.

71. A multipoint random control system as in Claim 69, wherein said signal bus provides separate common ground signals relative to each of said first and second electrical signals.

72. An initialization circuit having a capacitor, said initialization circuit having a charging time constant and a discharging time constant, wherein said charging time constant being less than said discharging time constant, said initialization circuit being provided in an electronic circuit, such that when said

electronic circuit is in a first operating mode, said capacitor is charged according to said charging time constant, and such that, when said operating mode is interrupted, said capacitance discharges at said discharging time constant, thereby preserving a memory of said operating mode.

73. An initialization circuit as in Claim 72, further including a second discharging time constant less than said first discharging time constant, said second discharging time constant providing a discharge of said capacitor to reset initialization circuit from said operating mode.

74. An initialization circuit as in Claim 72, comprising:

a diode;

a capacitor coupled between the cathode of said diode and a ground terminal; and

a resistor coupled between said cathode of said diode and said ground terminal.

75. An initialization circuit as in Claim 74, wherein said capacitor comprises an electrolytic capacitor and a bidirectional capacitor coupled in parallel.

76. A method for providing a solid state electrical switch for controlling a electrical load, comprising:

coupling a semiconductor switch serially to said electrical load by a first terminal and a second terminal to form with said electrical load a series circuit across said AC power source;

providing said semiconductor switch a control terminal for receiving a control signal, wherein

said semiconductor switch becoming conducting in response to said control signal and wherein said solid state electrical switch is in an "on" state when said semiconductor switch is conducting and in an "off" state when said semiconductor switch is not conducting; and

generating said control signal in a control circuit, said control circuit being coupled to said first and second terminals in a parallel configuration with said semiconductor switch.

77. A method as in Claim 76, wherein said control circuit being provided to draw substantially no current flows during said "off" state.

78. A method as in Claim 76, further comprising providing said control circuit power via said first and second terminals.

79. A method as in Claim 76 further comprising providing in said control circuit a dynamic feedback circuit, said dynamic feedback circuit through said control signal triggering said semiconductor switch during said "on" state into conducting at the beginning of each half-cycle of an AC signal of said AC power source.

80. A method as in Claim 76, further comprising including in said control circuit only solid state static components.

81. A method as in Claim 76, further step of generating said control signal comprising:

rectifying an AC signal received from said AC outlet into a rectified signal;

charging a capacitor by said rectified signal, when said switch device is conducting; and

discharging said capacitor in response to an electrical signal to provide said control signal.

82. A method as in Claim 76, further comprising providing said electrical signal through an external agent coming into contact with a touch panel, said electrical signal being generated as a result of an impedance of said external agent.

83. A solid state electrical switch as in Claim 82, wherein said electrical signal is synthesized by complementary effects resulting from the interaction of environmental electric fields and said impedance.

84. A method as in Claim 82, wherein said impedance is primarily resistive.

85. A method as in Claim 82, wherein said impedance is primarily capacitive.

86. A method as in Claim 82, wherein said electrical signal being generated as a result of said external agent collecting electromagnetic radiation in the agent's environment.

87. A method for providing an electrical switch for delivering AC power to a load, comprising:

providing a semiconductor switch circuit coupled in series with said load, said semiconductor circuit entering a conducting state when triggered by a trigger signal received at a control terminal, and entering a non-conducting state when a predetermined circuit condition is met; and

providing a feedback circuit which provides said trigger signal in response to said non-conducting state of said semiconductor switch.

88. A method as in Claim 87, wherein said predetermined circuit condition occurs when an AC voltage signal of said AC power crosses zero.

89. A method as in Claim 87, further providing, in said feedback circuit, a capacitor coupled between an input terminal of said semiconductor switch and said control terminal, wherein when said semiconductor switch enters said non-conducting state, said AC power provides a charging current to said capacitor, thus providing said trigger signal to said semiconductor switch.

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90. A method as in Claim 87, further comprising:

providing an activation circuit which provides an activation signal in response to an external stimulus; and

providing an initialization circuit responsive to said activation signal and coupled between said control terminal and a ground reference, said initialization circuit having a first state and a second state, wherein said initialization circuit preventing said trigger signal from reaching said control terminal when in said first state, and allowing said trigger signal to reach said control terminal when in said second state, and wherein said initialization circuit switches from said first state to said second state upon receiving said activation signal.

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91. A method as in Claim 90, wherein said initialization circuit is responsive to a deactivation

signal, said method further comprising providing a deactivating circuit responsive to a second external stimulus to provide said deactivation signal.

92. A method as in Claim 90, providing said feedback circuit such that, when said initialization circuit is in said first state, said feedback circuit conducts substantially no current.

93. A method as in Claim 90, providing said activation circuit such that, when said external stimulus is not present, said activation circuit conducts substantially no current.

94. A method as in Claim 91, providing said deactivation circuit such that, when said second external stimulus is not present, said deactivation circuit conducts substantially no current.

95. A method as in Claim 90, further comprising providing a ~~silicon~~ controlled rectifier (SCR) controlled bridge rectifier circuit coupled across said semiconductor switch, said SCR controlled rectifier provided such that, when said initialization circuit is in said first state, said SCR controlled bridge rectifier conducts substantially no current.

96. A method as in Claim 90, further comprising providing a beep circuit responsive to said activation signal to provide an audible sound.

97. A method as in Claim 96, wherein said beep circuit is provided such that, when said activation signal is not present, said beep circuit conducts substantially no current.

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98. A method for detecting contact of a touch panel by an external agent, comprising:

detecting a resistance of said external agent between said touch panel and a ground reference;

detecting a capacitance of said external agent between said touch panel and said ground reference;

detecting an inductive source imposed across said external agent by stray electromagnetic fields; and

providing a gain circuit including a control terminal coupled to said touch panel, said gain circuit providing an output signal when said resistance, said capacitance or said inductive source exceeds a predetermined value.

Sub A13

99. A method as in Claim 98 wherein said detecting being provided by a resistor coupled in series with said touch panel, a capacitor coupled between said touch panel and a first reference voltage, and a diode coupled in a reverse-biased configuration between a second reference voltage.

100. An overcurrent tripping circuit, comprising:

a semiconductor switch for coupling in series with a load, said semiconductor switch having a conducting state and a non-conducting state;

a control circuit coupled to said semiconductor switch, said control circuit receiving a control signal, said control signal causing said control circuit to enter a non-conducting state;

a current detector coupled with said semiconductor switch to provide an indicator signal indicative of a current in said semiconductor switch;

a rectifier for rectifying said indicator signal;

a threshold circuit receiving said rectified current signal to provide said control signal when said rectified indicator signal exceeds a predetermined value.

101. An overcurrent tripping circuit as in Claim 100, wherein said current detector comprises a current transformer.

102. An overcurrent tripping circuit as in Claim 100, wherein said rectifier comprises a half-wave rectifier.

103. An overcurrent tripping circuit as in Claim 100, wherein said rectifier comprises a full-wave rectifier.

104. An overcurrent tripping circuit as in Claim 100, further comprising a regulator for regulating said rectified indicator signal.

105. An overcurrent tripping circuit as in Claim 104, wherein said regulator comprises a zener diode.

106. An overcurrent tripping circuit as in Claim 90, further comprising a voltage multiplier circuit for said indicator signal.

107. An overcurrent tripping circuit as in Claim 100, further comprising a temperature automatic compensation circuit sensitive to the temperatures of said semiconductor switch.

108. An overcurrent tripping circuit as in Claim 107, wherein said temperature automatic compensation circuit is sensitive also to the ambience of said semiconductor switch.

109. An overcurrent tripping circuit as in Claim 107, wherein said temperature automatic compensation circuit comprises thermistors.

110. An overcurrent tripping circuit as in Claim 107, wherein said temperature automatic compensation circuit comprises a silicon diode with a negative temperature coefficient, such that said predetermined value is lower with a higher temperature.

111. A method for providing a solid state switch coupled in series with a load and an outlet of AC power, comprising:

providing a semiconductor switch coupled in series with said load, said semiconductor switch becoming conductor upon receiving a trigger signal at a control terminal, and becoming non-conducting when an AC signal of said AC power crosses zero volts;

providing a rectifier for rectifying said AC signal;

providing a first capacitor receiving said rectified signal, said first capacitor connected between said rectifier and said control signal;

providing an initialization circuit including a diode and second capacitor in series between said control terminal and a ground reference, said second capacitor having a larger capacitance than said first capacitor; and

initially providing said second capacitor in a discharged state, such that when said rectified

signal is shunted to ground reference through said diode and said second capacitor, such that said rectified signal charges said first capacitor to a charged state without creating said trigger signal.

112. A method as in Claim 111, further comprising:

providing a sensing circuit to provide an electrical signal when an external agent contacts an input terminal of said solid state switch;

providing a discharging path for discharging said first capacitor when said semiconductor switch is conducting; and

upon receiving said electrical signal, charging said second capacitor to a charged state through said diode, such that when said rectified signal charges said first capacitor, said charging creates in said control terminal said trigger signal to said semiconductor switch, whereupon said semiconductor switch becomes conducting and causes said discharging path to discharge said first capacitor, thus creating a feedback process regenerating said trigger signal.

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113. A method for providing an electrical switch with built-in over-voltage protection, comprising:

providing a semiconductor switch circuit coupled in series with a load, said semiconductor circuit entering a conducting state when triggered by a trigger signal received at a control terminal, and entering a non-conducting state when a predetermined circuit condition is met, wherein said conducting state, the impedance across said semiconductor switch circuit is substantially less than the impedance across said load; and

~~providing a feedback circuit which provides said trigger signal when a voltage across said semiconductor switch circuit exceeds a predetermined value, said feedback circuit being provided with an internal latch circuit such that, once said trigger signal is provided, said feedback circuit continues to provide said trigger signal to maintain said semiconductor switch circuit in said conducting state.~~

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